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GEOGRAPHY OF SOUTHEASTERN IDAHO*

by GEORGE ROGERS MANSFIELD

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Introduction.—The geographic study here presented in outline is an outgrowth of the Geological Survey's exploration of the western phosphate field. This work involved the detailed examination of many mountain ranges, ridges, and intermontane valleys, which presented interesting geographic features A comprehensive report covering these as well as other aspects of the investigation has been prepared for publication by the Survey. It has seemed advisable, however, to give the following brief, regional account in advance of the larger work, the appearance of which may be somewhat delayed.

Location and Salient Features.—The area to be discussed occupies the very southeastern corner of Idaho with narrow, adjacent strips of Wyoming and Utah and includes the Montpelier 30-minute quadrangle, together with the Slug Creek, Crow Creek, Lanes Creek, Freedom, Henry, and Cranes Flat 15-minute quadrangles and some adjacent country (Fig. 1). It lies mostly in the Northern Rocky Mountain province, as defined by a former committee of this Association,[1] but also

*Published by permission of the Director, U. S. Geological Survey. Read before the Association of American Geographers, at Cincinnati, Dec. 29, 1923.

[1] Fenneman, N. M., Physiographic divisions of the United States: *Annals Assoc. Am. Geographers*, vol. VI, pp. 19-98, Pl. I, 1917.

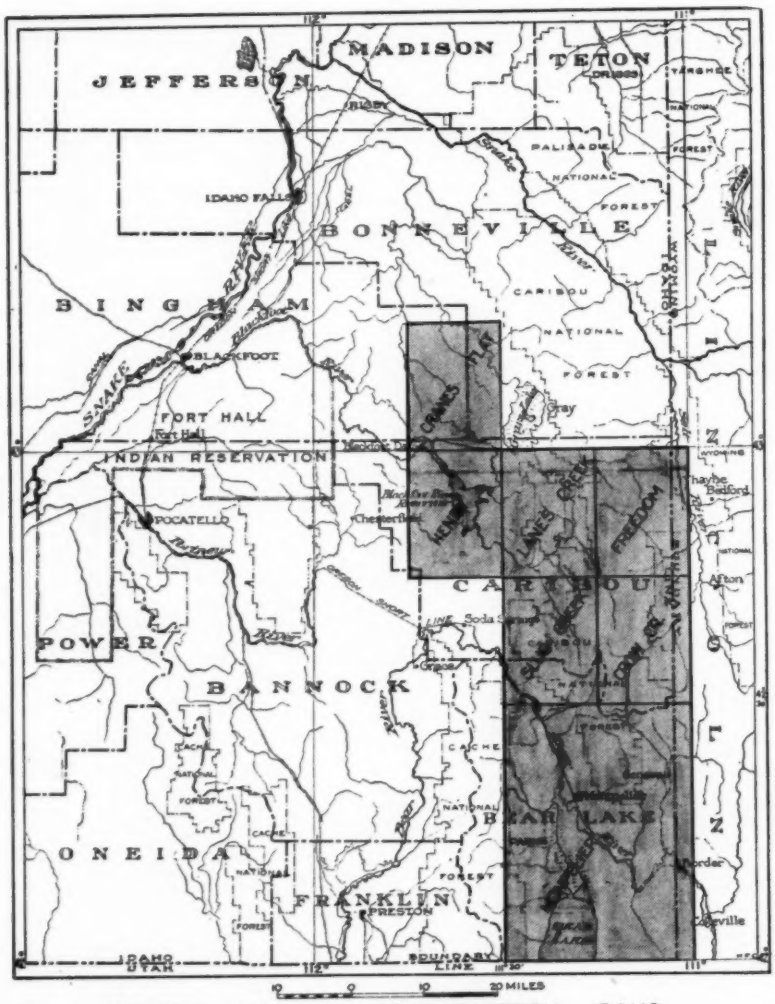


FIG. 1. GENERAL MAP OF SOUTHEASTERN IDAHO

includes part of the Nevada Basin section of the Basin and Range province and interfingering extensions of the Snake River Plain section of the Columbia Plateau province.

The principal mountain group of the region is the Idaho-Wyoming chain, which here forms the western border of the Northern Rocky Mountain province, and includes ranges and ridges with generally north or northwest trend varying in length from 5 to nearly 50 miles, in width from 2 to 10 miles, and in altitude from about 7,000 to nearly 10,000 feet. The broader and lower valleys, 5,800 to 6,500 feet above the sea, indicate the altitude of the base above which the ranges actually rise. The drainage of the southern and southwestern parts of the chain within the limits mentioned is delivered by Bear River to the Great Basin. Bear Lake, fed by springs and by small streams chiefly from the Bear River Range on the west, is tributary to Bear River. The rest of the region is drained by branches of Snake River.

The Basin and Range province is here represented by a few minor ranges that are apparently fault blocks containing older, eroded structures and occupying part of the western border of the area. The extensions of the Snake River plain above mentioned are lava fields, surmounted here and there by craters, filling broad valleys between the two mountain provinces and reaching southward into the Idaho-Wyoming chain.

Early Exploration and Settlement.—As far back as the latter part of the eighteenth century this region was frequented by fur traders and trappers. The waters of the Green, Bear, and Snake rivers abounded in valuable fur-bearing animals and in the broad valleys the fur companies had their annual meetings with the trappers for trade. Here, too, occurred many bloody Indian conflicts. Irving gives an interesting picture of the life and activities of the trappers, traders, and Indians in his graphic account of the attempts of parties outfitted by John Jacob Astor to found a trading post at the mouth of Columbia River and in his charming story of the adventures of Captain Bonneville.[2] Bancroft[3] presents a very different picture of Bonneville and his expedition. He denounces Bonneville and censures Irving for his favorable presentation of the Captain.

The Astorians passed along Snake River on their way to the Columbia. They met with reverses at the hands of the Indians and endured

[2] Irving, Washington, Astoria, 2 vols, Phila., 1836.
——— ——— The adventures of Capt. Bonneville, U. S. A., in the Rocky Mountains and the Far West. Pawnee Ed., vols. 1 and 2, New York and London, 1898.

[3] Bancroft, H. H., Works, vol. 28, pp. 568-575, 1884.

many hardships. One of their parties[4] under Robert Stuart entered Bear River valley. After misadventure with a party of Indians they made their way to Salt River (on the eastern border of the region here described) and thence northward to Snake River. Here they were set upon by the same Indians and suffered the loss of their horses.

The agents of the fur companies and the trappers were familiar with the country, but their knowledge largely died with them. The names of some of them are, however, preserved in the nomenclature of the region.

Nathaniel J. Wyeth, a trader from Boston, who in 1834 built Fort Hall near the junction of the Snake and Portneuf rivers,[5] shared with Bonneville in buffalo hunting and its attendant festivities at the headwaters of the Blackfoot.

Frémont[6] in 1843 entered the valley of Bear River from the Green River Basin by way of Ham's Fork, following the emigrant route to Columbia River. He noted the attractive and fertile appearance of Bear Lake Valley and the fact that the emigrants paused there to feed and refresh their stock before proceeding with their tedious journey across the Snake River plains.

The old emigrant road to Oregon (Fig. 2) followed up the North Platte and Sweetwater rivers in Wyoming to South Pass at the southeast end of the Wind River Range. Thence it descended Dry Sandy and Big Sandy rivers to Green River, which it followed a few miles. It then cut across country to the junction of Ham's Fork with Black's Fork near the present town of Granger and thence ascended Ham's Fork to the divide above Bear River Valley, a little south of the region here described.

Thence it followed along Bear River to Thomas Fork (near border on the map, Fig. 1), which it ascended for two or three miles, then turned west across the southern end of the Preuss Range near the present settlement of Alton. From this point it continued northwest across the mountains, re-entering Bear River Valley a few miles south of the present city of Montpelier. Thence it followed the valley in a general northwest direction to and beyond Soda Springs. A commemorative monument has been erected on this route at Main and Second streets in Montpelier. The Oregon Short Line branch of the Union Pacific

[4] Op. cit., vol. 2, pp. 134-141.

[5] The correspondence and journals of Capt. Nathaniel J.Wyeth, 1831-6, edited by F. G. Young, *Sources of Oregon History*, vol. 1, pts. 3-6, incl. *Contributions, Dept. Economics and History*, Univ. of Oregon, pp. 146-147, 227, Eugene, Ore., 1889.

[6] Frémont, Capt. J. C., Report of the exploring expedition to the Rocky Mountains in the year 1842 and to Oregon and North California in the years 1834-44, pp. 132-139 Washington, 1845.

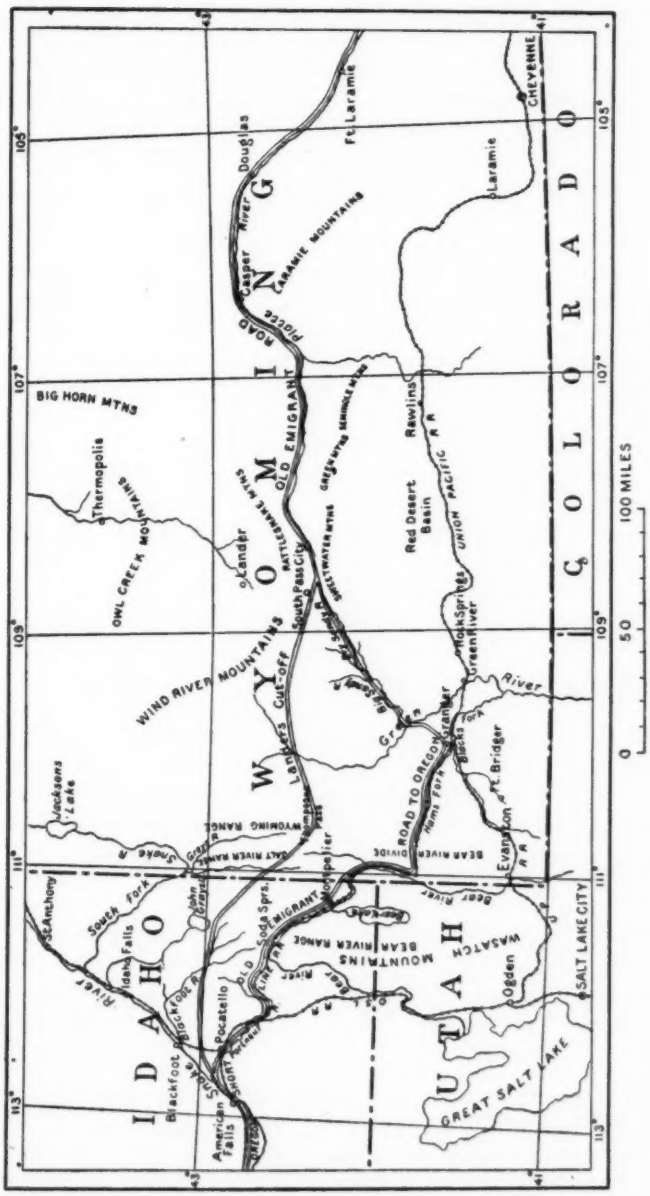


FIG. 2. Old Emigrant Road in Wyoming and Southeastern Idaho.

railway system from Granger northwestward now follows practically this same route, except that it keeps more closely to Bear River.

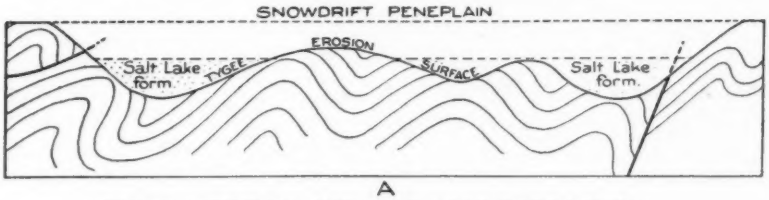
In the late fifties government parties were engaged in the selection of routes and the construction of wagon roads through parts of this region. Among the roads thus constructed is that now known as the "old Lander trail" or "Lander's Cutoff." It was planned "especially and emphatically (as) an emigrant road, so located as to avoid the tolls of bridges, alkali plains, and deleterious poisonous waters, and to furnish fuel, water, and grass to the ox-team emigration. . . . The overland emigrants reach the mountain sections in the latter part of July, and pass over the adjacent sand plains during July and August. The chief difficulties and obstacles which they encounter arise from the extreme dryness and heat of the artemesian (sage brush) deserts. The passage of the line as located nearer to the base of the snow-capped mountains, in a more elevated region richly grassed, and along the great summer trails of the Indians, is favorable to their health, the preservation of their stock, and gives them abundance of pasturage, with water at short intervals from mountain streams."[7] Parts of this road in the Freedom and Lanes Creek quadrangles are now impassable for vehicles but other parts are well used.

Before 1872 Bear Lake County was supposed to belong to Utah. It was first settled by a colony of Mormons under C. C. Rich, and was called Rich county. The establishment of the boundary of Idaho by survey threw the greater and better portion of Rich County into Idaho, together with its industrious and thrifty population, and it was considered as part of Oneida County until its separate organization in January, 1875. The first settlers were agriculturists, but their earlier efforts at farming were failures owing to frost and grasshoppers, which together took the greater part of their crops for several years. By making hay and raising stock the settlers prospered, and little by little overcame the worst of their difficulties.[8]

Summary of Physiographic Development.—In southeastern Idaho (Fig. 3) the highest ridgetops at elevations of about 9,000 feet probably represent remnants of a peneplain, here called the Snowdrift peneplain, developed in a region of complexly folded and faulted sedimentary rocks. The peneplain was dissected during the ensuing Tygee

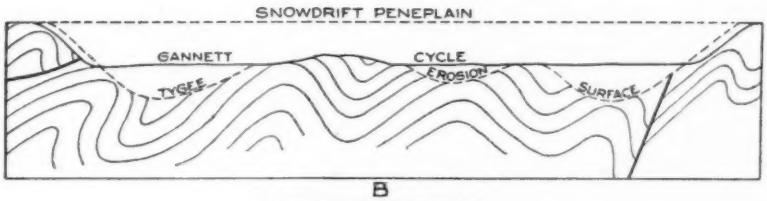
[7] Report of Supt. F. W. Lander upon the central division of the Fort Kearney, South Pass, and Honey Lake wagon road, constructed under the direction of the Department of the Interior, 1857-'58-'59. Senate Ex. Doc. No. 36, 35th Cong., 2d sess., vol. 10, pp. 47-73, p. 64, 1859. Map by W. H. Wagner.

[8] Bancroft, H. H., Works, vol. 31, History of Washington, Idaho, and Montana, p. 548, San Francisco, 1890.



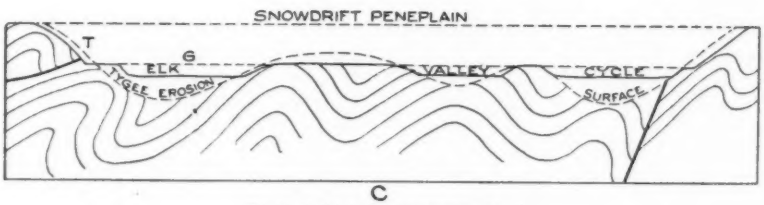
A

TYGEE EROSION AND SALT LAKE DEPOSITION



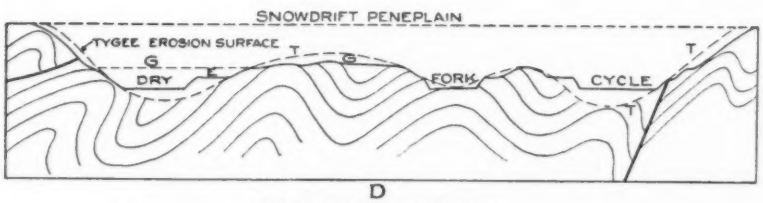
B

GANNETT EROSION



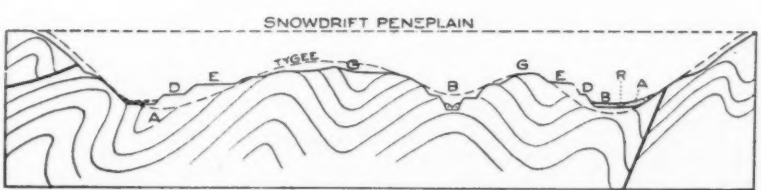
C

ELK VALLEY EROSION



D

DRY FORK EROSION



E

BLACKFOOT EROSION AND DEPOSITION

FIG. 3. Stages in Physiographic Development in Southeastern Idaho and Adjacent Regions.

cycle in which broad and deep valleys were excavated. These together with the lower neighboring uplands, were next extensively aggraded by the deposition of the Salt Lake formation. The region was then uplifted and again subjected to erosion through several succeeding partial cycles. About 1,000 feet below the peneplain stand remnants of the late mature Gannett erosion surface, above which unreduced remnants of the earlier dissected peneplain or of an intervening erosion surface now rise in some places as high as 500 feet Two later erosion surfaces, the Elk Valley and Dry Fork, stand at altitudes respectively about 300 and 600 feet lower. These form more or less well defined rock terraces above the present early mature canyons, here referred to the Blackfoot cycle, which themselves range in depth from a few hundred to 1,000 feet or more. Valleys of the Dry Fork or Elk Valley cycles now hang here and there 400 feet or more above the present valley bottoms.

Some of the broader valleys or intermont basins have been re-excavated in the buried valleys, which succeeded the peneplain. Others are in part of structural origin or have been eroded in rocks with favorable structures. Still other valleys owe their transverse courses to superposition, succeeding the aggradational cycle which came after the peneplain. All have been been aggraded to a greater or less extent, in the later part of the Blackfoot cycle, partly because of former arid climatic conditions and partly because of obstruction by basaltic flows in the lower valleys. Moister climatic conditions, probably associated with the latest glacial epoch, quickened the streams, notably Bear River, which rises in the glaciated Uinta Mountains, and permitted the youthful dissection of the aggraded material with the development of canyoned courses and graded reaches in some of the streams. Bear Lake, which occupies a re-excavated valley of structural origin in the southwestern part of the region, was developed to nearly twice its present size. Its highest level, maintained by alluvial fans, did not long persist, but superposition of its outlet upon buried ledges preserved the level of the lake long enough to develop shore lines, which may now be recognized at many places. Since glacial time little erosion has been accomplished.

The Physiographic Stages.—Space does not permit any detailed description of the respective physiographic stages. Since the stages here presented differ in some particulars from those worked out by others[9] in

[9] Blackwelder, Eliot, Post-Cretaceous history of the mountains of central western Wyoming: *Jour. Geology*, vol. 23, pp. 97-117, 193-217, 307-340, 1915.
Westgage, L. G., and Branson, E. B., The later Cenozoic history of the Wind River Mountains, Wyoming: *Jour. Geology*, vol. 21, pp. 142-159, 1913.

neighboring parts of western Wyoming and by the author[10] in earlier, less comprehensive studies in Idaho, the several interpretations are summarized for comparison in the accompanying table.

TENTATIVE CORRELATION OF EROSION STAGES IN WESTERN WYOMING AND SOUTHEASTERN IDAHO.

Western Wyoming				Southeastern Idaho	
	Westgate and Branson	Blackwelder		Mansfield See U. S. G. S., Prof. Paper in press. and Bull 713, pp. 14-17	
Epoch	Stages	Erosion cycle largely interglacial	Glacial Stages	Erosion cycles	
Recent	Late glacial and terraces	Post-glacial	....	Post-glacial	Spring Creek
		.....	Pinedale	Blackfoot cycle (St. Charles gl. episode)	Gibson
		Lenore	.....		
Pleistocene	Early glacial	.....	Bull Lake	.....	Putnam
	Plain No. 1	Circle	.....	Dry Fork	
	....	....	..... Buffalo	....	
	Plain No. 2	Black Rock	.....	Elk Valley	
	Plains Nos. 3 and 4	Union Pass	....	Gannett	....
Pliocene		Fremont (Wind R. summit peneplain)	.....	Deposition of Salt Lake formation	.....
Miocene	Reduction to peneplain by middle Tertiary	Middle Miocene deformation		Tygee cycle[9]	
				Middle Miocene deformation	
Eocene		Aggradation of earlier valleys		Snowdrift peneplain	

The correlation suggested by the table is purely tentative. No attempt has been made to force an agreement between the erosional stages of

[10] Mansfield, G. R., Geography, geology, and mineral resources of the Ft. Hall Indian Reservation, Ida.: U. S. Geol. Survey Bull, 713, 1920.

western Wyoming as given by Blackwelder and those of southeastern Idaho, yet the rather close parallelism of salient features as worked out independently in the two fields does strongly suggest such an agreement.

The Snowdrift peneplain is much less perfectly preserved than the Summit peneplain of the Wind River range as described by Blackwelder. In the last named region there are no Pliocene rocks and that epoch was devoted to erosion. Peneplanation is thought by Blackwelder to have been synchronous in western Wyoming and in Idaho and to have occurred in post-middle-Miocene time. The evidence for southeastern Idaho, set forth elsewhere,[11] seems to favor an earlier date.

The Tygee cycle, which according to the author's interpretation followed the Snowdrift peneplain stage, was presumably the time in which the larger topographic features of the present, such as the mountain ranges and intermont valleys, were outlined. Subsequently by aggradation many of these valleys became filled and the lower hills were overspread. No upland surfaces now remain that can with assurance be correlated with the Tygee erosion surface, although some of the residuals above the Gannett erosion surface, which follows next in order, may be related to the first named surface. This fact lends support to the view held by some that the erosion and aggradation of the broad mountain valleys, here ascribed to the Tygee cycle, preceded the peneplanation of the region (here the Snowdrift cycle). In the article above cited, however, it is shown that this view, which presents an attractive hypothesis, remains unproved.

The Gannett erosion surface agrees well in character with that corresponding to the Union Pass cycle of Blackwelder, though it is somewhat lower. Similarly the Elk Valley cycle may correspond with Blackwelder's Black Rock cycle. The Dry Fork cycle probably corresponds well with the Circle cycle of Blackwelder, and the Blackfoot and Lenore cycles agree in being represented by the present early mature inner canyons distributed throughout both regions.

Only the latest of the glacial epochs described by Blackwelder is represented in southeastern Idaho, but the St. Charles epoch to which is ascribed the moister climatic conditions that permitted the enlargement of Bear Lake and the accompanying renewal of erosional activity, did not otherwise directly affect the region under consideration.

In southeastern Idaho, as in western Wyoming, post-glacial erosion has accomplished little. The lava flows in the main valleys serving as temporary base levels have controlled the grades up valley from the

[11] Mansfield, G. R., Tertiary planation in Idaho: Paper accepted Jan., 1924, for publication by *Journal of Geology*.

respective flows and have delayed general down-cutting. In the Fort Hall Indian Reservation adjacent to Snake River farther northwest the Spring Creek cycle or episode has been recognized

Climate.—The climate of southeastern Idaho has been described in an earlier paper[12] and needs only brief mention here. It is semi-arid with an annual rainfall of about 14 inches, and a mean annual temperature of about 41° but with strong contrasts between summer and winter temperatures and with marked extremes of temperature both monthly and annual. The prevailing westerly winds and the other climatic factors are modified to some extent by local physiographic conditions. The growing season averages 86 days but varies greatly in different parts of the region.

The list of climatic stations available for study is given in the paper cited. Practically all are valley stations though some, such as Afton and Bedford, are immediately at the base of the mountain range. None are actually on the slopes or summits of the mountains.

Vegetation.—The vegetation responds actively to the climatic conditions, varying in character and distribution with exposure to sun and wind and with the distribution of moisture and of temperature. The moister bottoms are covered with reeds, rushes, and wild grasses, which furnish an inferior hay. The lower mountain slopes and foothills, together with the drier bottoms, are largely covered with sagebrush, interspersed with grasses and weeds that are utilized for grazing. The mountain slopes up to elevations of about 8,000 feet have numerous and extensive groves of aspen, while below and above that elevation important growths of red fir and other conifers are maintained.

A pronounced difference is to be noted between the growth on the west and southwest slopes and that on slopes facing east and northeast. Because of the lingering snows in the lee of the ridges and the less effective sunshine for melting and evaporation, the east and northeast slopes retain a greater amount of moisture and support a heavier growth of vegetation. Here many of the middle and lower slopes are occupied by abundant brush, which, when combined with aspen groves or with timber and fallen logs, forms thickets that are difficult to penetrate. The observer who looks eastward from any favorable high point sees chiefly the relatively bare west slopes and may get the impression that the country has little tree growth. If he looks westward, however, and sees the wooded eastern slopes he may think of it as well timbered.

[12] Mansfield, G. R., The climate of southeastern Idaho: *Annals Assoc. Am. Geographers*, vol. XI, pp. 75-92, 1921.

Animal Life.—The drier slopes were once the haunt of numerous rabbits and other small game. These have been largely killed off with the advance of settlement. The great abundance of rodents in dry meadows and on the gentler dry slopes is locally a menace to crops. Large game, though once abundant, is now relatively scarce. In the early days of the explorers and emigrants the broad open valleys were roamed by large herds of buffalo. Their places have since been taken by cattle and horses, while sheep now graze on much of the mountainous area. Occasional bear, deer, and elk may be seen in the mountains, but they too are making way for advancing occupation of the country by man. Coyotes and occasional wolves still menace the live stock here and there. Beaver, which once inhabited many streams of the region and were eagerly sought by the early trappers, have been legally protected from extermination for the past few years and may still be found in a few of the streams. Game birds, chiefly several species of the grouse family, occur in diminishing numbers on the sage-covered slopes and in the wooded areas. Ducks and other water birds frequent the larger streams and marshes. Song birds are numerous and of considerable variety. Fish, which were formerly abundant, are becoming relatively scarce, and the streams must be restocked if the supply of desirable food fish is to be maintained. The introduction some years ago of carp in Bear Lake has proved unfortunate, as these have increased in great numbers and menace the more desirable types. Insect life is abundant and varied, and though troublesome at certain times and places is probably not more so here than in other parts of the Rocky Mountain region.

Natural Resources.—Aside from the timber and agricultural possibilites, to which some reference has already been made, the region has vast mineral wealth, chiefly in the form of phosphate rock, but there are also water, both for power and irrigation, building stone, limestone suitable for the manufacture of lime and cement, salt, road material, and other minor mineral resources.

Transportation Facilities—Bear River Valley affords one of the natural gateways from western Wyoming and northern Utah to Snake River and the northwest. Selected by the trappers and emigrants, and later followed by the railroad, it has become part of a great transcontinental route, along which pulsates the commerce of many states. The Oregon Short Line Railroad, a member of the Union Pacific System, follows this route and crosses the southwestern corner of the region here described. Branch lines have been constructed respectively from

Montpelier and Soda Springs to phosphate mining camps a few miles distant. The railroad has also made two preliminary surveys from Idaho Falls, Idaho, up Snake River to Jackson, Wyo. The proposed route lies along Snake River to the mouth of Salt River and thence up the transverse canyon of the Snake to Jackson's Hole. At present most supplies for towns along the Wyoming border between the mouth of Salt River and Bear River valley are hauled from Montpelier or Cokeville distances ranging up to 50 miles or more. Freighting over mountain roads is beset with many difficulties, especially in winter, and is expensive. With a railroad at the mouth of Salt River, or even extended southward, much of this hauling will be eliminated.

Aside from the scattered villages at favorable places the region is sparsely settled. Fair wagon or automobile roads traverse most of the larger valleys and are thus generally parallel with the trend of the mountain ranges. Transverse roads are relatively few and far between, so that distances by road between localities among the mountains are frequently considerably greater than their actual distances.

Industries.—The alluvial deposits in Bear Lake valley, Salt River (Star) valley, and the valleys of the larger streams at elevations ranging from 5,700 to 6,000 feet or more furnish considerable areas for irrigated fields that produce a variety of valuable crops, among which are wheat, oats, rye, alfalfa, hay and potatoes. At favorable places such as along the west side of Bear Lake small fruits are successfully raised and are of excellent quality. The bottom lands, too cold or wet for cultivation, yield important crops of wild hay that support large numbers of cattle. The practice of dry farming is increasing rapidly and all the larger soil areas, whether irrigable or not are being rapidly taken up for cultivation. In the lava covered districts water is relatively scarce and at certain localities, as in the region north of the Blackfoot River Reservoir, must be hauled for domestic use or for stock or must be obtained by expensive drilling.

The mountains yield local supplies of timber which is sawed into rough lumber by sawmills here and there. Dressed lumber is largely shipped in by rail. The mountains also, through the grazing regulations of the United States Forest Service, are made available for the summer pasturage of large numbers of sheep and cattle.

Phosphate rock is mined in Montpelier and Paris canyons and at Conda, the newly established town of the Anaconda Copper Mining Co. about 9 miles northeast of Soda Springs.

Montpelier in Bear Lake County and Soda Springs, the county seat of the newly established Caribou County, are the principal shipping

and distributing centers of the region. Cokeville, about 30 miles southeast of Montpelier in southwestern Wyoming, is a similar shipping and distributing center and maintains mail stage connections with Star Valley to the north. This service was formerly rendered by Montpelier. Each of these towns is on the railroad and is favorably situated to serve as a junction point for up country routes with the valley of Bear River.

Physiographic Work of Man.—The occasional finding of the skull or horn of a buffalo or bighorn recalls the primitive inhabitants of the country before the arrival of civilized man. Now the irrigation ditch, with its train of irrigated farms with cultivated fields, the dry farm, and the advent of improved farm machinery are rapidly changing the desolation of sage-covered slopes and dreary wastes into attractive and picturesque rural communities, which give added charm to the mountain scenery.

The work of man, through the construction of ditches and reservoirs, is modifying the conditions of water circulation both as surface and as ground water. The diversion of mountain streams for irrigation interferes with their normal work of surface erosion, delaying or accelerating their degradational or aggradational effects and altering the concentration and distribution of alkalis and other soluble constituents of the soils. The stabilizing of Bear River by the construction of a canal connecting it with Bear Lake, and of Blackfoot River by the construction of the Blackfoot River Reservoir are examples of the work of man that may have a noteworthy influence upon future physiographic activities in the region. The impounding of water in the Blackfoot River Reservoir has already affected the flow of streams and the activity of ground water in the territory a few miles to the south.

REGIONAL GEOGRAPHY OF SOUTHEASTERN WYOMING FROM THE VIEWPOINT OF LAND CLASSIFICATION

By STEPHEN SARGENT VISHER*

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INTRODUCTION.—How much land is required to enable an average American family to make a living? Of course the answer varies with the location and quality of the land. On the outskirts of New York or many other cities, an acre of truck land sometimes suffices. In unirrigable portions of the Nevada desert, a township might not yield a sure income sufficient to support an average family.

The unappropriated American public domain has been open for settlement in units of 160 acres since the passage of the Homestead Act of 1862. Under this act a man already owning 160 acres cannot homestead additional land. By 1890 most of the land of the type capable of supporting a family on 160 acres had been appropriated. Hence, for years most of those homesteading were compelled by grim necessity to violate the spirit of the homestead law. They either sold or leased their homestead, because they could not make a living on it, or else they bought or leased additional land, so as to obtain a unit of sufficient size to enable them to make a living. Recognizing the need for larger homestead units, Congress in 1909 and 1910, passed two enlarged Homestead Acts, which permitted the homesteading of 320 acres of non-irrigable land. In the next few years millions of acres were filed on in units of 320 acres, and by 1916 once again the land still remaining open to settlement was for the most part of so poor a quality that few homesteaders could obtain a reasonable living from

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a 320-acre unit. Hence Congress again increased the homestead unit, to 640 acres in case the land was designated as "stock-raising land" by the Secretary of the Interior. In order to be so designated, the land must be capable of supporting an average American family on a 640-acre tract but incapable of maintaining one on a 320-acre tract. Thus the land applied for required classification Conditions arising out of the military activity of the nation made a prompt classification desirable. Shortly after the passage of the Stock-raising Homestead Act (Dec. 29, 1916), the American military forces were being enlarged very rapidly. As the period of military service of soldiers and sailors reduces the residence requirement on homesteads, many young men wished to file on a homestead before going off to war. Since formal filing was prohibited until the land was classified, there were numerous urgent requests from Congressmen that the Survey promptly classify the land desired by their constituents. Abundant funds were supplied the Survey, and much else was done to facilitate the work of classification.

The field men who made the surveys reported to the Land Classification Board of the Geological Survey, which in turn reported to the Secretary of the Interior, who did the formal classification.

The southeastern portion of Wyoming contained much public land, in March, 1918, practically all of which had been "applied for" under the Stock-raising Homestead Act. Some 1,300 applications were pending in the southeastern counties. Members of the Land Classification Board wondered if the land is of such a quality that laborious individual examinations of each tract were necessary to determine whether or not it was "320 acre land" (enlarged homesteads), or if much, if not all of it, might fairly safely be designated as stock-raising land (640-acre homesteads). The writer, in 1918 Land Classifier in the Survey, was assigned the task of studying the entire region and reporting upon the general conditions, upon the amount of water apparently still available for irrigation, and upon the distribution of timber land. Another question was whether or not any large portions of the area were of such poor quality that the making of a respectable living on a square mile unit was impossible. Officially it was decided that an American family could not make a living by stock-raising on 640 acres of land which would not support twenty-five cattle for a seven-months (or longer) grazing period.

Southeastern Wyoming is a transition region. Physiographically, although nearly all of it is in the Great Plains, the western border reaches elevations of over 7,000 feet, upon the so-called Laramie Mountains. It is near the southern edge of the Northern Great Plains, and has

some features of the Southern Great Plains. Likewise, all of the major types present in the unglaciated portions of the Great Plains are represented. Wind sculpturing, dunes, buttes, cuestas and rock terraces are especially well developed and there are some fine badlands. In respect to rainfall, it is in the fluctuating semi-arid belt; in temperature considerable contrast is shown between the higher western areas (6,000-8,000 feet) and the lower lands (4,000-5,000 feet) near the North Platte River and the Nebraska boundary. In respect to wind, too, much of the region is intermediate between mountain and plain. Many types of soil are present. Agriculturally, southeastern Wyoming is an area in which grazing, dry farming, and irrigated farming are all practiced with varying degrees of success. In some small areas dry farming succeeds fairly well, in others irrigation, but elsewhere neither can be carried on successfully. Stock-raising, too, has serious handicaps.

The field investigation (made in April and May, 1918) and the study of available literature which were the basis for the report submitted to the Land Classification Board were illuminating to the writer, and it is hoped that a brief summary of that report will interest other geographers.

Southeastern Wyoming has long been the most densely populated and best developed large section of Wyoming. In 1890 it contained more than one-fourth of the state's population of 62,000 persons, and in 1920 over one-sixth, although it comprised only one-fourteenth of the area. Its population in 1920 was about 36,000, of which about 14,000 were in Cheyenne, the capital and chief city of the state. There are several towns of less than 1,000 The Union Pacific Railway crossed the area in 1868 and a number of other lines were built in the following decade or two. This region has long had comparatively good railroad service. Consequently, human adjustments to geographic conditions are more complete than in many newer areas of the West.

Location, Area and Relief.—Southeastern Wyoming, as here defined, contains Laramie, Goshen and Platte counties, with a total of 7,100 square miles, which is an area nearly as large as Massachusetts or as the combined areas of the three smallest states. Figure 1 locates the chief towns, streams, railroads and relief features. Most of the area is a rolling plain sloping eastward from the Laramie Mountains which lie along the western margin.

Types of Land.—Several types of land are recognized:

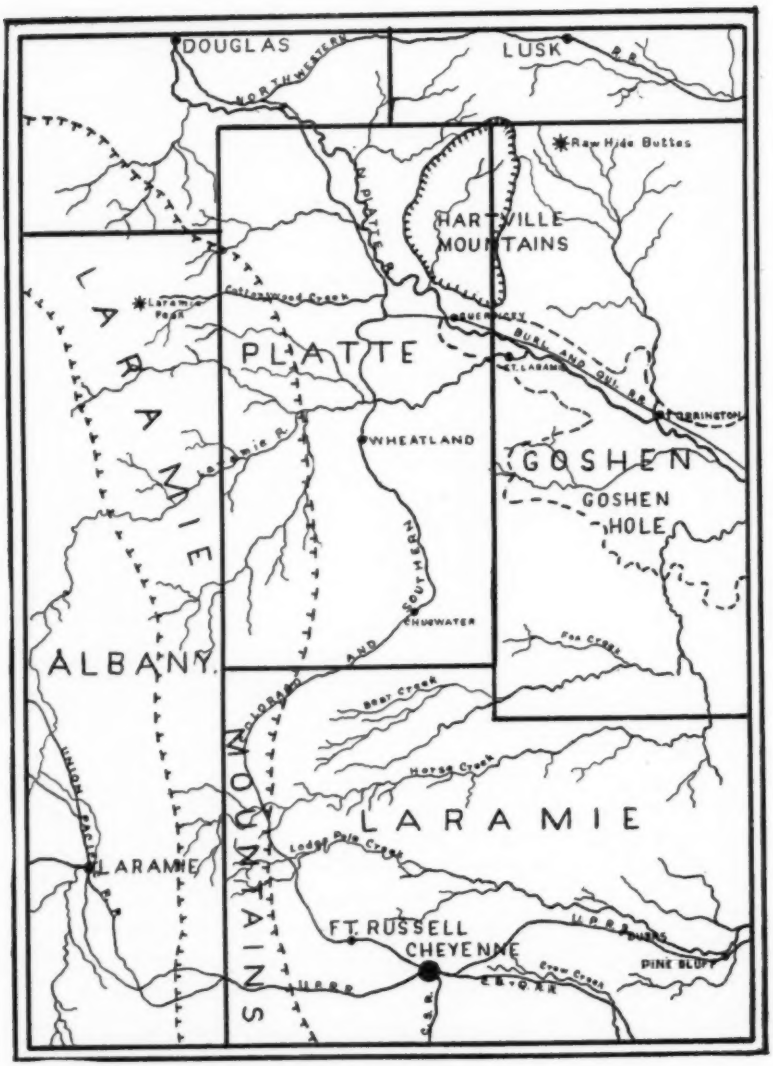

FIG. 1. Southeastern Wyoming

Smooth Lands.—This type consists of gently rolling plains. The cultivability is high, averaging more than fifty per cent; the soil is fairly deep, and mostly of good quality; there is almost a pure stand of short-grass except on the clays, where wheat-grass prevails; abundant water is available at depths of less than three hundred feet. Very few areas are stony.

Land of this type occupies most of Laramie County, much of the southern half of Goshen and Platte counties and small areas elsewhere. It is nearly all patented. Its topography is well illustrated on the Cheyenne and Goshen Hole topographic sheets.

Sandy Areas.—The second type, far less extensive than the smooth or the rough types, is the land which is so sandy that tillage is unwise. The main dune tracts are clearly indicated on the geologic map of the Patrick and Goshen Hole Quadrangles. The remaining dune-area observed is in Townships 20 and 21 N., Ranges 65 and 66 W. In addition to these areas of active dunes with their large bare patches, there is a large, mainly grassed-over, area of dune sand in northern Goshen County. Bare spots occur on many hill sides, however, and apparently all that is necessary to lead to dune-development is to break the sod.

The characteristic vegetation in the dune-sand is relatively tall grass of three kinds: sand grass, needle grass, and in the hollows, bluestem. Grama grass is found between the taller grasses Although sand grass and needle grass are not choice forage, they make sufficient growth, especially in the hollows, that they may be mowed for hay profitably, and this is often done. Because of the tall growth of the grasses where not mowed or grazed, snow less frequently interferes with winter grazing than is the case upon the short grasses. Hence all-the-year-round grazing is prevalent. The carrying capacity of the sandy areas was estimated at even a higher figure than the average for the entire region, several estimates being in excess of 75 head of cattle per 640 acres.

Rough Lands.—The rough lands possessing a compact soil comprise the third type. In them the possible tillage acreage is much reduced; the soil is fairly deep on the more level parts but thin or even lacking on the steeper slopes; the vegetation ranges from an almost pure stand of short-grass on many of the more level stretches (which make up a considerable share of the entre acreage), to a very scant growth of poor vegetation on the steepest slopes. Shrubs, especially the inedible skunk bush, are prominent on the steeper slopes, and in parts of the area, black sage or scrubby pine and juniper are conspicuous.

The relief averages perhaps 400 feet per square mile. The carrying capacity of these lands is estimated quite generally at from 30 to 40 head per 640 acres without forage, or fully 50 head with the forage which could be grown.

The rough lands of this sort are of three subtypes: "breaks" along valleys, buttes, and the Laramie Mountains.

"Breaks."—The chief "breaks" are along Horse and Bear creeks in northern Laramie and southern Platte counties, a tract some 15 miles wide and 40 miles long extending east-northeast from the northeast corner of the Sherman Quadrangle across the northern end of the Cheyenne Quadrangle into Goshen County.

According to contour maps of parts of this area, the local relief commonly exceeds 100 feet and in some places approaches 400 feet. However, there is sufficient fairly level surface (rock-terraces and peneplains) so that on even the roughest square mile seen, perhaps 80 acres could be cultivated in narrow strips; and on all but the roughest, enough fields of 10 acres or more to total 80 acres could be tilled readily. On many of the 640-acre tracts, 160 acres or somewhat more could be tilled in units of 20 or more acres.

The soil in this particular block is mostly similar to that of the smoother lands to the south, a loam with enough large feldspar crystals to give a fine-gravelly aspect to an eroded or wind-swept surface. Rock outcrops are numerous as are areas of thin soil.

Besides these Horse Creek-Bear Creek "breaks," there are a number of similar areas along the western tributaries of Chugwater Creek, between the North Fork of Laramie River and North Platte River, and between Goshen Hole on the east and Chugwater Creek on the west. Smaller rough areas occur in each quarter of the region.

Buttes.—The second sub-type of rough lands are those in or near buttes or mesas. The largest mesa, known as Hartville Mountains, is in northeastern Platte County. It has been rather extensively eroded, but is well grassed-over and is an attractive grazing area with several clear streams, pine-dotted hillsides and grass-covered "flats." The highest butte is Rawhide Butte in eastern Platte County. The steep, higher slopes are rather thickly wooded, but there is fine grazing on the lower slopes, and numerous areas of a few acres in extent could be tilled. East of the butte is a badland area of less value. Also north of North Platte River are Haystack Butte (just east of Hartville Mountain), Spoon Butte, Pine Ridge, and a number of smaller buttes. South of the North Platte Valley are Bear Creek Mountain and Eagle Rock,

outliers from the escarpment which marks the western side of Goshen Hole.

These buttes and escarpments present conditions sufficiently similar to make it unnecessary to discuss each separately. There is a rather sharp contrast between the relatively smooth summit levels, (except in the case of the conical Rawhide Butte) and the steep, in some places unscalable, slopes. The more level tracts are well grassed-over with a good growth of short-grass Many of the steeper slopes are bare. With few exceptions these buttes and escarpments may be fairly readily approached from one side, and stock can find their way up one or more of the remaining sides.

Springs are found along the contact between the rather porous formations which make up the bulk of these elevations and the underlying relatively impervious formation. However, most of the better springs are in patented land. In case in should be necessary, wells could be secured even on the summits by penetrating to the semi-impervious formation. Although the distance which water would have to be pumped is great, nevertheless, with the help of the wind, which is powerful on such exposed points, adequate stock water could be obtained.

Laramie Mountains.—The third sub-type of the rugged lands is the Laramie Mountains. This range is a low dome cut by moderately deep, fairly wide valleys, through which small but permanent streams flow. Few slopes in this area are so steep that they cannot be ascended on horse-back. There are numerous tracts of many acres in extent which could readily be tilled, and there are only relatively few square miles which have no more than 20 acres smooth enough to till. Perhaps fully 80 acres could be tilled in scattered pieces, on all but the poorer 640-acre tracts. An indication that this range is not truly mountainous is afforded by the automobile roads. Many cross in different directions; for example, in the Sherman Quadrangle, which includes the highest points in the range except Laramie Peak (10,000 feet), the contour map shows not a single group of four sections of land (2 miles on a side) which is not bordered or crossed by a road. Furthermore, the average elevation of most of the divide is less than 500 feet higher than the highest portions of the plains to the east However, a number of sharp domes rise above the general level of the range reaching elevations of from 700 to 1,300 feet higher. According to the topographic map of the Sherman Quadrangle, the average relief per square mile is about 500 feet, many having a relief of less than 350, but a few reach 1,000 feet and the roughest one reaches 1,300 feet.

The soil varies from a deep alluvial loam in parts of the valleys and locally on the peneplain surface, through a gravelly or rocky clay-loam to no soil at all on the steepest slopes. Most 640's have no considerable extent of rock outcrops.

In general, the range is grass covered, only a relatively small fraction being barren or thickly brush covered in this area. The shrubs and trees do not greatly reduce the amount of grass. The dominating vegetation is short-grass, but various bunch grasses are locally conspicuous, as are also sage-brush, skunk-bush, and mountain mahogany. Here and there near the tops of the steeper and rockier slopes, especially on north-facing slopes, there the western yellow pine, not nearly enough or of good enough quality, in this area, however, to be classed as merchantable.

Drainage.—The North Platte River crosses the northern part of the area, most of which is drained by its tributaries. (See Fig. 2.)

Two special drainage features merit mention, however, namely, "blowouts" and "waterholes." Scattered over the plains are numerous slight undrained depressions, called "blowouts," from a few inches to a few feet in depth and a few acres or less in extent. They contain water for a short time after heavy rains or thaws. In the sand dunes, deeper blowouts are present, some of them reaching a depth of 15 feet or more, and in few cases where their bottoms are on impervious clay, they contain water most of the year.

Undrained depressions known as water-holes, having a less simple origin than that of the blow-outs, are found particularly in Goshen County, where because of slight slope and a sandy covering, the drainage is poorly developed. Most of these water-holes are only a few rods across, and a very few feet deep, but many contain water all year. Water-holes are assets partly because artificial reservoirs, in the porous soils of most of the region, leak badly until they are gradually silted up, which takes years. Consequently they are rare.

Temperatures.[1]—The winters are relatively cold with occasional severe storms and, because of the high elevation, the summers are comparatively cool for the latitude, temperatures of more than 95° F. being rare in most of the area. The Chinook influence of the prevailing west

[1] The data upon which the following discussion is based were found in "The Summary Climatological Report for Southeastern Wyoming (based on all records up to 1909)," the "Annual Climatological Reports for Wyoming," 1910 to 1917 inclusive, and the "Special Reports for the Cheyenne Station" for 1916 and 1917. Additional official information was obtained from the meteorologist in charge at Cheyenne, a regular Bureau Station since 1871.

winds results in higher average winter temperatures than are experienced farther east.

At Cheyenne and Fort Laramie 47 and 40-year records reveal an average winter temperature (December to March, inclusive) of about 28° F. Temperatures of —30° F. or lower are experienced occasionally, Cheyenne reporting a minimum of —38° F. and Ft. Laramie one of —48° F.

The average temperature, May to August inclusive, (hereinafter referred to as the growing season), is 61° F. at Cheyenne and 65° F. at Ft. Laramie. The highest monthly average recorded for Cheyenne was 72° F. in 1881 and in only seven years since 1870 were monthly averages of 70° F. or over recorded, all in July. At Ft. Laramie the normal temperature for July and August is 72.5° F. and 71.5° F., respectively. The absolute maximum temperature at Cheyenne is 100° F. (July, 1881), but temperatures of 95° F. are rare, and temperatures over 90° F. are only recorded for June, July and August. At Ft. Laramie the maximum record is 106° F., and temperatures of 90° F. or over have been recorded in each of the seven months from April to October, inclusive, at some time during a 15-year period. Four months, June to September inclusive, have had temperatures of 102° F. or over. These summer temperatures illustrate the influence of altitude, Cheyenne being 1,800 feet higher than Ft. Laramie.

Growing Period.—The following table shows the dates of killing frosts and length of growing period for this area:

TABLE I. FROST DATA

Station	Elevation in ft.	No. years record	Average last killing frost in spring	Average first killing frost in fall	Average growing period	Minimum growing period
Cheyenne	6088	47	May 21	Sept. 18	119 days	78 days
Wheatland	4700	10	May 11	Sept. 24	135 days	78 days
Lusk[2]		16	May 25	Sept. 13	110 days	78 days
Ft. Laramie	4270	15	May 15	Sept. 20	127 days	86 days
Pinebluff		9	May 27	Sept. 19	114 days	85 days

The comparatively long frost-free period of Wheatland is associated with the good air drainage due to its location on a terrace, and that at Ft. Laramie is apparently due to its elevation of less than 4,300 feet.

[2] Lusk is a short distance north of the northeast quarter of the area.

Killing frosts have been recorded in the spring as late as June 11 at Cheyenne, June 6 at Ft. Laramie, and June 20 at both Lusk and Pinebluff; and in the fall as early as August 20 at Cheyenne, September 1 at Ft. Laramie, August 20 at Lusk, and September 12 at Pinebluff. Hence the absolute frost-free season at Cheyenne has been only 78 days, at Ft. Laramie 86 days, and at Pinebluff 85 days.

The cool nights which prevail because of the altitude and aridity, should be mentioned in connection with the relatively short growing season because low night temperatures check plant growth.

The latitude of this part of Wyoming is about 42° N., and the early summer days are not long enough (as they are in North Dakota) to largely offset the relatively short growing season, by markedly increasing plant growth.

Wind.—Relatively high winds are common. The average hourly velocity at Cheyenne is 13.6 miles per hour, ranging, so far as monthly averages are concerned, from 9.4 miles per hour in August to 17.6 miles in January. Gales are frequent. In 1917 there were 92 days when winds of 40 miles or more per hour blew at Cheyenne, and velocities in excess of 60 miles per hour were attained in five months. The maximum velocity for the year was 78 miles per hour on January 8. In 1916 there were 66 days with gales of 40 miles or more per hour and velocities of 60 miles or more occurred during six months. The maximum velocity for the year was 78 miles per hour, the same as in 1917. In 1918 the maximum velocity was 76 miles per hour, on February 5. Velocities in excess of 65 miles per hour have very seldom been recorded at regular U. S. Weather Bureau Stations, even on the Great Plains. As Cheyenne is not especially exposed, it is apparent that this area is exceptionally subject to high winds. Its elevation and the relatively steep slope eastward (nearly 100 feet descent per mile, on the average) both tend to increase the velocity of westerly winds.

The summer months are distinctly less windy than the winter months, and very high winds are much less frequent. Winds in excess of 40 miles per hour were recorded only 8 times in the growing season of 1916 and 6 times in that of 1917. The maximum velocities in those periods were 66 and 65 miles per hour, respectively.

Northwest and west winds prevail, except during June and July, when most of the wind comes from the south.

Precipitation.—The annual precipitation averages about 15 inches in this general area, according to the records of a decade or longer at six fairly well distributed stations. The fact that the oldest and most re-

liable stations, Cheyenne, Ft Laramie, and Laramie (just west of the area) all record average precipitations well under 15 inches (13.8, 12.5 and 11.0 inches respectively) suggest that the proportion of this area having a precipitation of more than 15 inches will ultimately be found to be smaller than that indicated on rainfall maps based on shorter records. However, fortunately for vegetation, nearly 75 per cent of the precipitation occurs during the warmer six months, April to September, inclusive.

The rainfall of any particular week, month or season, is the vital biologic factor, however, not the average amount received in that period. In fact, averages commonly are quite misleading. In this area, as elsewhere in the Great Plains, precipitation is exceedingly erratic, the annual total ranging, at Cheyenne, for example, from 5.0 inches in 1876 to 22.7 inches in 1905, and at Ft. Laramie from 5.6 inches in 1886 to 27.1 inches in 1915. Rarely does it approximate the average; commonly it is much less than the average or else considerably more. Of more significance than the annual total is the rainfall during the growing season. The mean total rainfall for May, June, July and August is 7.4 inches at Cheyenne, but only 3.6 inches were received in 1876, although 15.5 inches fell in 1908.

The unreliability of the rainfall may be illustrated by June, probably the single month of most agricultural significance here. At Ft. Laramie, with a normal of 1.8 inches, the rainfall in June, 1872 and 1888, was less than 1-10 of an inch, and in 1910 only 1-3 of an inch. At the other extreme, it was 4 inches in June, 1913, and 4.8 inches in June, 1909. At Cheyenne, where the normal June rainfall is 1.6 inches, as little as 0.01 inches of rain has been received (June, 1876). In 1914 there was only 0.25 inches. The wettest Junes were in 1900 (4.0 inches), and in 1883 and 1889 (3.7 inches each)

There is another aspect of the precipitation which is unfavorable for agriculture. Much of the rainfall occurs as sudden downpours, relatively little of which soaks in, except on loose soils or on areas of little slope. Another considerable portion of the precipitation falls in such small amounts that it does little or no good to crops, though it does aid the grasses which have a net of roots very near the surface.

At Cheyenne there is an average of 88 days per year (41 days in the growing season) in which enough rain falls to be classed as rainy days by the Weather Bureau. The average rainfall on each such day is 0.15 of an inch. Investigations by soil-physicists indicate that ordinarily more than twice this amount must fall in a day in order to be helpful to crops. Such a small amount as one-seventh of an inch of rain, or as

King states in "Soils," even as much as half an inch, commonly make tilled soils drier than before, by increasing capillarity, which in turn increases evaporation.

At the other extreme, is a record at Cheyenne of 4.7 inches of rain in 24 hours, July 15, 1896. This amount is more than one-third the average annual rainfall. In May and September, likewise, downpours in excess of 2.7 inches have occurred in 24 hours. Hail is frequent during the wetter years.

Snowfall is usually scanty in winter, and the frequent strong winds normally drift it, leaving most of the area bare. Thus the snow seldom interferes seriously with grazing.

Sunshine.—Cheyenne receives sunshine during an average of 66 per cent of the possible number of hours. The cloudiest month is May, with 57 per cent, and the sunniest months are October and November, each of which receives 70 per cent.

Relative Humidity.—The air (or space) at Cheyenne has, on the average, 64 per cent of all the moisture it can hold at 6 A. M. and 46 per cent at 6 P. M. January usually has the driest mornings (56 per cent at 6 A. M.), and May has the wettest (72 per cent at 6 A. M.). September is the driest month at 6 P. M. (36 per cent), and February wettest at 6 P. M. (55 per cent). Thus the relative humidity is much lower in summer than in winter or spring. These humidity records are comparatively low, about 25 per cent lower than those common in the eastern half of the United States.

Evaporation.—The U. S. Bureau of Plant Industry has kept records of the evaporation from a pan of water at Archer, near Cheyenne, during the months of April to September, inclusive, since 1914. An average of 36 inches of water is evaporated in these six least windy months, the season totals ranging from 30.3 to 40.9 inches. The highest monthly evaporation recorded was for August, 1914 (8.5 inches), and the least for April, 1916, (3.4 inches.) The rainfall during these six months of the four years, 1914-1917, averaged 10.1 inches, equal to only 27 per cent of the average evaporation. Most evaporation occurred during the driest year and least during the wettest year.

AIR PRESSURE AND ITS RESULTS.—The average air pressure at Cheyenne, 24.1 inches, is 20 per cent less than that at sea level. Consequently the air has 20 per cent less substance and wind has 20 per cent less force than at sea level. In other words, a wind velocity of 50 miles per hour there is no more powerful, in foot-pounds, than a wind of 40 miles per hour at sea level. However, the 50-mile wind is the more

effective of the two in increasing evaporation and in various other ways.

The thinness of the air, besides greatly increasing radiation of heat, also notably increases the evaporation of water, as the rate of evaporation of water depends to a large degree on the vapor tension. In a near-vacuum, luke-warm water will boil away.

It is obvious that the quality of the sunlight is different at high than at low altitudes, and it is claimed by ecologists that plants are able to use sunlight in their physiological activities more effectively where it is filtered through less air, as it is at high elevations, than at sea level.

SOILS.—Although there is a strong tendency for the soils in dry, windy climates to be similar, in this area several types occur, derived from radically different rock formations. As differences in soil texture appear to be critical in respect to dry farming, as will be shown later, it is desirable to discuss the soil types. The soil of most of the area is a sandy loam. It is comparatively poor in humus and hence is generally light-colored. The amount of alluvium is not considerable because of the narrowness of the valleys. However, near Wheatland, a wide terrace, already mentioned, is capped with alluvium over an area totaling about three townships in extent. This tract is mostly irrigated.

Soil maps are not available, but maps of the geologic formations are, and, with the help of the following data, permit of approximations as to the distribution of soils.

The chief rock formations are the Arikaree, Brule, Laramie and Ogalalla, each with more or less distinctive soils. The distribution of these formations and of others of importance, with the soils commonly derived from them, are briefly described below.

This area has along most of its western or Laramie Mountain border a narrow belt of pre-Cambrian rocks, mostly granites and schists. Bordering this on the east are small, irregular areas of Paleozoic and Mesozoic formations. Upon the flanks of the Laramie Mountains and extending to the Nebraska boundary, and thus covering most of this area, are poorly consolidated or unconsolidated Tertiary formations, chiefly the Brule and Chadron members of the White River Formation, and most extensive of all, the Arikaree Formation, of Miocene age. Within this area of Tertiary rocks there are four chief areas of other sorts of rock. The largest is in Goshen Hole, where Laramie beds (Mesozoic-Cenozoic transition) occupy several townships. The second area extends from Rawhide Butte southwest to Glendo. In this area, pre-Cambrian schist reappears along with other pre-Tertiary formations. The third area is in the north-central Platte County, where, in an area about six townships in extent, redbeds and Paleozoic lime-

stones outcrop. The fourth exception to the general prevalence of the Oligocene or Miocene formations on the plain are two considerable areas of Ogalalla formation (Pliocene) in eastern Laramie County.

The Arikaree, the most widespread rock formation, consists mainly of sand loosely cemented into a soft sandstone that contains limestone concretions. The soils from this formation range from a firm, sandy loam to dune-sand. The latter gives rise to dunes in the northeastern quarter of the area, north of the Platte River.

The Brule, the next most widespread formation, is in most places a clay with lenses of compact, fine, but soft sandstone. It readily erodes, on steep slopes, into badlands. It yields a soil varying from clay to sandy loam. Where the clay aspect is found, as it is in most of this area, the soil is generally thin and somewhat barren.

The Laramie Formation yields a clay to clay loam. However, considerable sand has blown or washed upon the area where this formation outcrops in Goshen Hole and hence some parts have a sandy soil.

The Ogalalla is prominent for its lenses of sandstone and beds of gravel, but it has enough clay also to yield loam which ranges from a sandy loam to a gravelly loam.

The soils on the pre-Tertiary formations are mostly fine sandy loams to gravelly loams, on the granite. In many places the soil is quite deep, but as these formations outcrop mostly in the more mountainous sections, there are many small, barren patches

Surface Waters.—This area is fairly well supplied by permanent streams, most of which flow eastward from their source in or near the Laramie Mountains, or southward from Rawhide Butte and Hartville Mountains. The discharge of the streams varies greatly, the North Platte having by far the greatest, with an average of 1,470,000 acre feet April to November, 1901 to 1908. Laramie River is second, with an average of 181,000 acre feet, May to October, 1895 to 1903 (not continuously). Horse Creek is probably third. Lodgepole Creek has a discharge of from 3 to 10 second-feet most of the year, but occasionally reaches 48 second-feet.[3]

The intermittent and temporary streams are fairly numerous and at one time supplied a large share of the stock water. Wells along such valleys are still important sources of domestic and stock water.

Much irrigation is done in this region, most of it from North Platte River in the U. S. Reclamation project of that name. However, an ex-

[3] Oscar E. Meinzer: Irrigation in Lodge Pole Valley, Water supply paper 425 B 1917.

tensive area (more than two townships) is irrigated from Laramie River or its tributaries near Wheatland, and numerous small areas along the other chief streams.

Nearly all the land along streams, much more than there is water to irrigate, was patented under the Desert Land laws or the Carey Act, or before these laws were passed. The State Engineer, when questioned on this point, declared that without extensive storage, very little more land could be regularly irrigated in this region because the waters of all streams in this region have been " vastly over-appropriated."

GROUND WATERS.—The water plane lies at a depth of from 100 to 200 feet for most of this region, as shown by many wells, and from other information. In the valleys it is rarely necessary to go so deep, many wells in such places being less than 50 feet deep. Upon the " tables " and along the broad divides, many wells are somewhat deeper than 200 feet; the deepest learned of is about 300 feet. By penetrating the Arikaree Formation, which has an average thickness of perhaps 250 feet in much of this area, an abundant supply of good water commonly is secured at its contact with the rather impervious Brule Clay. The water rises approximately 50 feet in most wells, making the distance it must be pumped some 100 to 150 feet in most of the area.

According to Adams[4] most springs in about one-third of this area are at the contact between the porous Arikaree and the more impervious Brule. This relation was observed elsewhere in this region.

Water obtained from the Tertiary formations is good, and wells yield sufficient water for stock and domestic purposes at depths that are not prohibitive. The persistence and strength of the winds make the use of windmills feasible, even on relatively deep wells, and, as a result, windmills are numerous in the settled areas.

The one extensive formation in this area which yields poor water is the Laramie, in southern Goshen county (Goshen Hole).

Artesian flows are obtained 20-30 miles northwest of Cheyenne from the Foxhill Sandstone, which underlies the Chadron. The Dakota Sandstone underlies all but the northwestern third of the region and yields excellent flows, where tapped, but carries too much mineral matter to be suitable for intensive irrigation. Furthermore, according to Darton, it lies from 2,000 to 4,000 feet below the surface in this particular area, except just east of the Laramie and Hartville Mountains.

[4] George I. Adams, Geology and Water Resources of the Patrick and Goshen Hole Quadrangles, Water Supply Paper 70, 1902.

VEGETATION.—Perhaps ninety per cent of this area is covered by an almost pure stand of short grass. Four genera are particularly important. Grama grasses predominate, but on the hillsides especially, the less valuable three-awn-grass, Aristida (locally called "wire grass") is common. Buffalo grass and a sedge ("nigger wool") also occur widely. The stand of short-grass is so close in most places that it nearly conceals the soil. Shrubs and herbs are few in most of the region. The best stand of pure short-grass is found on slightly sandy, clay-loam soil and a good carpet of these grasses indicates that the soil will not "blow", when plowed, and that it is rather deep. Where the soil is more sandy, sandy enough so that it will "blow" if not handled properly, needle-grass (Stipa) is abundant and gives a whitish cast to the vegetation much of the year. Where the soil is very sandy, so sandy that tillage is impracticable, sand-grass (Calamovilfa) is dominant, and its long decumbent stems give a conspicuous yellow tint to the landscape except during the early summer. Wherever sand-grass occurs in dense patches instead of being thinly scattered, the soil is so sandy that, where plowed, it is blown badly after it has been worked a few years, and the grass roots have decayed. These correlations between vegetation and soil texture are closely similar to those worked out in western South Dakota.[1]

On hillsides, especially where the soil is a clay loam, the stand of short-grass is not close enough to cover the ground, and various other plants are also found. Most conspicuous of these, where the rock near the surface is somewhat calcareous, is the skunk bush (Rhus trifoliata). Where the soil is thin on gravelly hills and also where the sub-soil is sand, soap weed (Yucca) is conspicuous. On the latter type of soil the black sage (Artemesia tridentata) is abundant just south of Goshen Hole. Sage occurs somewhat generally on loam soils, above 5,000 feet in elevation, in the northwest quarter of the area.

On the heavier clay soils, represented in this area chiefly on the Brule and Laramie formations, wheat-grasses predominate. Patches of wheat-grass are found along flood plains and in many of the shallow blowouts on the sandy loams due to the silting which has occurred. Valley sage (Artemesia ludoviciana) is abundant on the heavier soils also, but rare elsewhere.

An interesting correlation between the distribution of burrowing animals and soil types was noticed. Gophers of two sorts and prairie dogs are quite abundant on clay loams and on sandy loams with a clay sub-

[1] S. S. Visher, Biogeography of the Southern Great Plains, *Geogr. Rev.* Vol. II pp. 89-115, 1916 and The Geography of South Dakota, Bull 8 S. D. Geol. Surv., 1918.

soil. They are uncommon on soils that are sandy enough to be blown badly and are lacking in the very sandy areas. The lack of permanence of their burrows in the sand doubtless is the reason for their absence from such areas. Where the soils are thin, gophers are rare also.

Trees, chiefly cotton woods and willows, are found only along the deeper valleys in the smoother parts of the area and are scarce even there. On the sides of buttes in the northern half of the area, and along the escarpment bordering Goshen Hole, there are scattered western yellow pine and juniper. Although these trees are valuable for firewood and fence posts, they are not merchantable timber.

Agriculture.—For more than fifty years this area has been extensively used for stockraising. Soon after the passage of the Enlarged, 320 acre, Homestead Act in 1909, the number of homesteaders increased until open range grazing was largely replaced by small stock ranches, by dry-farming, and by a combination of dry-farming and stock-raising.

Dry farming was introduced about 1900 into the area bordering Nebraska, north of Pinebluff, and has been carried on there ever since, but the great stimulus to dry-farming came with the passage of the Enlarged Homestead Act in 1909. Since then most of the better land, not already appropriated, has been homesteaded in 320 acre tracts. Many of these settlers are taking the opportunity afforded by the Stock-raising Homestead Law of Dec. 29, 1916, to increase the size of their homesteads to 640 acres, (where public land is available within the 20 mile limit set by departmental regulation) and it is significant that of the 1248 applications pending in May, 1918, less than 300 were original entries.

Most of the settlers are not attempting to do dry-farming alone, but are combining dry-farming with stock-raising, or even reducing dry-farming merely to producing forage to supplement grazing.

Dry farming alone has not yet passed the experimental stage, but the success of a small amount of dry-farming in connection with stock-raising is well established.

Under the climatic conditions which prevail here, a rather light sandy-loam appears to be best, so far as crop growing is concerned, for the three localities where dry-farming is being carried on with best success are on such soil. Where the soil is compact enough not to be blown considerably by the high winds which prevail here, the slight rains apparently do not penetrate rapidly enough to reach the crop roots before

evaporating. If a torrential rain occurs, the heavier soils pack badly and the water runs off, if there is a slope, or the rainfall evaporates before doing much good to the crops.

Mention is made of these relationships of light soil to present success in dry-farming because, where climatic conditions are so unsatisfactory as here, the success to be achieved in cereal culture probably will not be adequate to hold the better farmers, those who are capable and willing enough to handle the light soils so carefully that they will not be badly blown by the high winds which frequently prevail. Such men will logically go to areas, after they have accumulated some capital, where they can use their skill with more assurance of success or else go into stock-raising or dairying with cash-crop farming as a minor aspect. If only the more careless farmers continue to cultivate large areas, it is likely that after a few years, when the grass roots are dead, many fields on the lighter and apparently superior soils will be blown so badly that they no longer can be worked at all advantageously. There are already numerous abandoned or ready-to-be-abandoned fields In any case the high wind is sure to supplement deficient rainfall in preventing any continued use of much of this area for cereal dry-farming.

As there are few indications of successful dry-farming on the heavier soils, and large areas of these soils are most favorably located in respect to markets, and have long been patented, it seems safe to conclude that under methods which have been so far developed, dry-farming has not been really successful here on compact soils.

Hence, though it was conceded by several farmers who had been here for several years, that with wheat at $1.50 per bushel, a family could make a living on 320 acres, we suspect that even the soils best suited to dry-farming in the area will not yield enough for a period of years to make any part of this area a truly successful dry-farming-cereal region on the 320-acre basis. Even the most enthusiastic farmers asserted that a family could not "get ahead" on 320 acres, and that any capital which they themselves had accumulated was made possible by supplementing their 320-acre homestead by leased land, and by stock-raising.

Chief Crops.—Wheat is the chief cash crop of the region. Spring wheat is preferred because it avoids winter killing which is particularly common, an adequate snow cover being rare and intense cold snaps and high winds frequent. Land left in the stubble over winter is less likely to have the soil blown away than land on which there is a poor stand of winter wheat. On the other hand, winter wheat has the advantage of maturing earlier than spring wheat, and thus being more likely to escape the frequent summer droughts. The yields of the two varieties

average about the same, ranging from 8 to 15 bushels per acre with occasional total failures. During fairly favorable years, wheat-yields of 12 bushels per acre are not uncommon. The average yield, year by year, is perhaps 8 bushels per acre.

Flax is grown to a small extent, especially as a sod crop, and could be grown much more extensively than at present. It is less susceptible to drought than wheat, and because of its high value per pound it is desirable for the settler who is a long distance from market.

Forage crops are the ones most vital to the homesteader in this region as they are used primarily to supplement the grazing of livestock. The grain crops are quite commonly cut for hay, when the season is unfavorable for the maturing of the grain. Rye, corn, oats, and millet constitute the principal forage crops.

Rye is valuable as a forage crop because of its dependability. It often affords considerable pasturage during the fall and winter, and is sometimes allowed to mature and then is threshed for the grain.

Corn is probably the best forage crop for altitudes below 6,000 feet, and is grown quite extensively at present. However, because of the cool nights and the short growing period, corn seldom ripens, and hence its chief use is for fodder or ensilage. Ordinarily it produces about a ton per acre, which is more than the other forage crops normally yield.

Oats are planted primarily for the grain and yields from 20 to 30 bushels per acre when the season is favorable. If the season is not favorable for a good yield of grain, the crop is cut early and makes good hay, being the most palatable of the grain hays. However, the oat is not so dependable as rye or corn, and is not grown extensively. Neither of the sorghums have proved successful here, except in Goshen Hole, where the elevation is less than 5,000 feet.

Alfalfa is being grown by many of the homesteaders, but not very profitably except under irrigation. It is drought resistant, but its water requirement is much greater than that of the cereals grown and of some other forage crops.[6] The yields of unirrigated alfalfa are quite low here, except during years of abnormally high precipitation. At Archer, for example, the average yield for three years for alfalfa in cultivated rows was 0.6 tons per year per acre, and of broadcast plats still less. Irrigated alfalfa is produced in large quantities, however, in Goshen Hole and near Wheatland.

Millet is grown to some extent for hay, and seems adapted to even the poorest lands of the area. With average rainfall, it produces a fair crop of hay, and starts a second growth which is used for pasturage.

[6]. Briggs and Shantz, Water Requirement of Crops, Bulletin, U. S. Dept. of Agriculture.

Brome and sudan grass appear to be adapted to the climatic conditions of the area, and although not widely grown as yet, promise well for the looser soils as they form a dense, matted turf.

Beans have been grown with moderate success north of Bloomington, and also potatoes of a good quality and fair yields.

Markets.—Along the railway lines of the state there is a good demand for farm products, especially milk, butter, eggs, poultry and garden truck, because of the numerous railroad towns and coal mines and oil fields. Wyoming supplies only about one-fifth of its demand for pork, dairy and poultry products. Most of the grains, likewise, are needed to supply the local demand.

GRAZING.—This area is still an important stock-raising region, as it has been since the late sixties, when a railroad first approached. Only a very small fraction of the area is tilled, and much of that is used for the growth of forage crops.

This area, though it comprises only one-fourteenth of the state, contained in 1910, approximately one-sixth of the cattle, one-eighth of the horses, one-fifth of the swine and one-fourteenth of the sheep of the state. At the state census of 1915, the ratios remained practically what they had been in 1910 except in respect to sheep, in which there was a marked falling off, this area having then only one-fifth its proportional share.

Fencing is very general, only a rather small proportion of the region being unfenced.

The grazing period in this area is nearly twelve months, stock on the range being fed only during severe storms or when the grass is covered with snow. In exceptionally hard winters, as in 1916-17, stock may be fed as long as 90 days, but in ordinary years they are fed less than 30 days. Winter grazing is made possible by the character of the climate. In this region there is almost no precipitation between August and May, aside from a little snow. Consequently the nourishment is not leached out of the standing grass, making it nearly worthless, as in humid areas. In fact, stock will fatten readily here on dry grass, "natural hay," in the winter or spring if they have enough of it. Because of frequent high winds in winter, snow rarely covers any large fraction of the area, and thus stock is able to get at the grass practically all winter.

The carrying capacity of the range is generally estimated at from thirty adult head of cattle to the 640 acres for twelve months grazing period, to twice that number. Most of the residents consulted believe,

that with a proper growth of forage crops to supplement grazing, more than twenty-five head of cows and their young calves can be maintained per square mile on even the poorer grazing land in this area, and for the average of the area, nearly twice that number. On the smoother land with good soil, fifty head could be supported, they say, without forage, and fully seventy-five head, with proper use of forage.

This relatively high carrying capacity is a consequence of the highly nutritious character of the native grasses and their fairly dense growth. Though most of the area has a turf which is quite short, few of the blades extending more than five inches from the ground, there is little waste land, little bare ground, and few inedible plants.

SUMMARY AND CONCLUSIONS.—Southeastern Wyoming is a transition area on the mountain border of the Great Plains. Dry farming is fairly successful on the lighter soils into which the rainfall of even the moderate showers characteristic of the region commonly penetrates to the depth of the crop roots. Upon heavier soils which are far more extensive and more easily handled in this windy region, on the other hand, although there is sufficient penetration to benefit the shallow-rooted short-grasses, most of the all too meagre rainfall (less than 15 inches on the average) does not benefit the crops. Although nearly three-fourths of the precipitation falls during the six warmer months, in certain other respects the rainfall distribution is decidedly unfavorable. It is very erratic, and a large share occurs as sharp showers each of which yields, on the average not over one-third of an inch. Upon slopes, the run off is rapid, except on porous soils. Partly because of the high elevation (5000-8000 feet) winds of high velocity are common, evaporation is very rapid, the nights are cool, and the growing season often short.

Agricultural experience in the region and climatic and other geographic conditions indicate that the area is adapted to stock raising rather than to farming. Upon the little remaining land that may be irrigated and upon remaining tracts suitable for dry farming, forage crops can be produced more profitably than grains. With the help of the forage which may thus be produced, even the poorer sections will carry sufficient cattle to support (according to the official definition of "support") a thrifty family. But on the other hand, it is believed that none of the land still public in May 1918 is capable of yielding permanently by dry farming, a reasonable living for a family on a 320 acre unit. Hence the designation of the public land of this area as stockraising land was recommended by the writer.

THE AMERICAN INDIAN AND GEOGRAPHIC STUDIES

By WILLIAM H. HANS

INTRODUCTION.—Whatever may be said of the past treatment of the American Indian by the race which displaced him, there is at present a most general and sympathetic interest in this original American and in his past accomplishments. Travellers in South America find little more arresting than those marvelous ruins of the Incas, representative of the golden age of a people whose present condition is as striking, in contrast, by its wretchedness. Similarly in our own Southwest the "Easterner" who sees the Indian ruins for the first time manifests an interest that is quite in contrast with the blasé attitude of the hardened tourist. Strangely enough, the geographer remains indifferent. Perhaps naturally so, for the Indian, though he may pique his curiosity, does not mean much to him individually, nor to the whole nation economically; and it is from an economic standpoint that we are most likely to judge of the importance of things. This, in the main, is the reason also why the geographer's interest has been chiefly in economic, less in political, and still less in social geography, the field into which most Indian studies fall.

There is no point in giving the Indian a status which he does not merit. The fact, however, needs to be emphasized that for serious geographic study his achievements rarely are considered comparable, even in a minor way, to those of the white man. We are wont to measure geographic worth-while-ness not by the fundamental geographic laws that we may discover, but by the present importance of the material we are dealing with. In other words, we make geographic studies less for the sake of the science of geography than for the economic results obtainable. Geography from this point of view is not looked upon as a pure but as an applied science. This, it would seem, is unfortunate for a science is built up by the working out of laws and principles, rather than by the variety of phenomena it may attempt to interpret, no matter how important economically.

It is taken for granted these days that an animal in his organic evolution is an adaptation to the environment within which he prospers. If for any reason the environment changes, he must adapt himself anew, or being unable to do this, he must migrate to more favorable regions if he is to survive the change. Similarly it may be taken for granted that man in his cultural evolution, under the more primitive conditions at least, is a fair adaptation to his environment also; and that if his environment changes he too is subject to the same laws. The Indian

in his cultural evolution developed a remarkable regional adaptation in many parts of the New World and thus offers many exceptional opportunities for regional geographic studies of a comparatively simple type. However, with the advent of the white man his old environment gradually began to take on new elements, and he too was faced with the problems of adaptation, migration or extinction.

In this cultural evolution, however, a new factor enters which is more assertive than in organic evolution—that of self direction. Man decides how the actvities of his group are to be ordered. These activities thus planned are not always directed along the most natural lines but may even go contrary to nature's laws. This factor, however, enters into all geographic study for few peoples make the most of their natural resources under the existing physical conditions or even follow the lines of least resistance to attain the end sought. In many sections of South America one is impressed with the unusual possibilities, along a number of lines, were only the ethnic conditions slightly different. In primitive cultures this factor is less evident than it is in peoples of higher types; consequently the Indian's environmental relationships are simple and excellently adapted for simple regional studies which might serve as working models for beginning students. Unfortunately, however, there is no such geographic literature to which the student may turn, and he is forced to plunge at once into the most complex relationships.

The field for geographic research along these lines is not easy, for the field is not only large but also the basic material is widely scattered in a literature much of which is unreliable. Only in some phases is field work at present possible. As no attempt has been made to organize the material from a geographic viewpoint there is the added difficulty of working in an uncharted field. The following is suggested as a possible working subdivision: (1) The early cultural evolution, the beginning of things; (2) the geographic relationships at or just prior to the advent of the white man, the condition approximately of the highest cultural stage; (3) the decadence. Each of these divisions is quite distinct from the others and offers many opportunities for subdivisions.

Cultural Evolution.—If cultural evolution is largely the result of environmental conditions, then, of course, it is a legitimate field for geographic studies. The geographer thus far, however, has taken little or no interest in this type of investigations, although the type of research is such that, reasonably, one might expect much from him. Some most excellent work has been done in recent years by men working

in other fields, and as so many of their results have such a strong geographic bearing it leads to the presumption that the geographer might throw much light on the many problems which have arisen, although for much of his basic information he will have to rely on other lines of research.

The big problem, of course, is how to account for the comparatively slow progress made by the Indian when the physical environment seems so especially favorable for present day activities. If the environment is really the vital factor in both cases, then the conclusion must be that what is best for one stage of culture is not necessarily the best for another. In other words, the Indan found an environment, now considered one of the best, highly unfavorable for progress, so much so that he was far outstripped by the two other centers of cultural evolution, the one in southeastern China and the other, roughly, in the eastern Mediterranean Basin. The Chinese culture unquestionably far exceeded it, and the other, the Near East, spreading throughout Europe, passed immeasurably the other two. It seems almost unbelievable that the Indian should have lived here since the glacial period with little change while civilizations in the Old World rose again and again to fall and disappear.

In the attempt to solve this problem others arise, and from these still others. One of them soon to arise is with what traits did he start? Were they of such a nature as to give promise of growth, or, like some in the organic evolution of the past, were they such as to lead into blind alleys from which it was hard or even impossible to find a way out? In other words, were the environmental conditions responsible or was it a matter of inheritance of past conditions? If he had started differently would the progress have been more rapid? The geographer, of course, is not to prove that the environment is the leading factor but to add his mode of attack that truth may prevail.

To attempt some of these investigations is soon to find out how meagre our knowledge of basic material still is. At present we know so little of these facts that our investigations seem to be blocked at every turn and the whole tied up in a hopeless knot. However, on the other hand, when not following any special clue, one is surprised also by the large amount of geographic material extant awaiting someone to make out of it a geographic whole. Facts, however, interpreted definitely as geographic relationships are few and widely scattered.

The best mode of solving these problems seems to be through the primary needs of man—food, clothing, and shelter. Of these food is the most important as its urge is ever present and not to be preter-

mitted, coloring almost every phase of activity. A region is favorable or unfavorable chiefly as food is forthcoming, and under the best of conditions the major time and thought are given to it. The native learns the tricks necessary to get the required amount whether it be of game, fish, berries, nuts, or maize and through it develops certain active traits. Since he has not learned to gather or use the foods in a region differing from his own, it is possible for him to succumb in the midst of plenty. Even the white man had to have a Stefansson to show him how to live in the "fruitful" Arctic.

It is also to be remembered that studies related to our activities are largely those of occupations. Each occupation is much of a world in itself of which people in another occupation know relatively little. Our life, therefore, is centered around a differentiation of activities, that of the Indian around individuals. The only differentiation of activity was that of sex, and even here the general picture of a lounging buck and a working squaw is untrue, for in the main, the major activities fell to the males and the minor ones to the females.

Geographic Relationships at Time of White Invader.—When the white man came he found many different types of culture. The Eastern Woodland Indian was an agriculturist of no mean rank. The products of his fields and preserved foods more than once saved the early colonists from starvation. He lived in long rectangular wooden houses of peculiar pattern. His social and political ideas were highly developed, for we need to recall only the "League of Six Nations." In the plains region the culture centered around the buffalo. In the typical sections he knew not how to fish, nor how to plant, but he had developed a high technique in the preparation and use of skins. As he migrated with the buffalo, the tipi, no simple affair, served his purpose admirably. The Southwestern Plateau Indian again lived from the products of the soil, and maize was the chief kind of food; but he developed his own technique quite different from other regions where maize also was grown. This was the chief occupation and the men in the main did the sowing and reaping and weaving, and not the women. Social and religious customs and beliefs took on new aspects here. Thus different sections, differing materially in natural conditions, had distinct cultural traits.

Thus both continents may be divided into numerous cultural groups and sub-groups. Because of a greater range in natural conditions the North American groups are more numerous than those of South America. The common misconception that some groups were mere savages and others showed an unusual degree of advancement is due

to the fact that we are wont to measure others by ourselves. The more evident thing like a house of a thousand rooms seems much more important than that which is less striking such as beautifully worked leather or a piece of exquisitely woven cloth. There were differences in cultural evolution, it is true, but not the quantitative differences as assumed in the common conception.

The relation of the Indian to his environment is very marked. In the eastern woodland with its open spaces the products of the soil were the chief standby. Because of the abundance of game meat also was an important element in the diet. On the plains where it would have been impossible to protect the crop the buffalo was the mainstay. Since the buffalo migrated with the seasons, so the Indian migrated also, another reason why he couldn't be an agriculturist. In our Northwest, much skill had been developed in preserving fish for the lean season. In the Southwest irrigation was developed to a remarkable degree. The same relationships may be shown relative to clothing, housing, and social and religious customs. In response to all needs the material at hand was made use of, and various degrees of proficiency were attained. Adobe houses were built where clay was abundant, cliff dwellings where caves existed; block houses in forested regions, and skin houses or tipis where skins were abundant and where it became necessary to move frequently.

The Decadence.—The replacement of one culture wholly, or only in part, by another totally different one should have much interest for the geographer. Or may it be that this is not a geographic but a social problem? Surely physical conditions have played a strong part and the geographer, to that extent at least, should lend a helping hand. In regions where the land was needed for homes the Indian had to leave, for the land could not be used to grow crops and yet remain a hunter's paradise. In such regions it became natural to speak of "a good Indian as a dead Indian." The two interests were unalterably opposed to each other and the one had to give way. The more evenly the forces were matched the more bitter the conflict. However, in such regions, the white man's frontier was this zone of struggle for supremacy and he won out because of the ever present push from behind.

In regions, however, that were meant to be exploited only, the conflict was less severe. Here the fundamental interests were less in opposition to each other. The Indian, if he would adapt himself to the new conditions, was welcomed as a helper. In such regions the more appropriate expression is "a good Indian is an enslaved Indian." But

here is where difficulties arose for the Indian could not and would not adapt himself to slave conditions. Therefore, in some sections, like in the West Indies and eastern Brazil, he became practically extinct and the negro took his place as slave. Under these more or less enslaved conditions amalgamation of races went on apace, and in regions of limited white immigration the dominant blood today is Indian still, yet under the control of his white conqueror and economically in a white environment.

The interest lies not only in the displacing of one culture by another, but in the extremely rapid divergence in rank after they meet, the one an offshoot of the Eastern Mediterranean in its onward march sweeps everything before it and in many respects leads the world; the other with amazing rapidity is going down and down. To realize how great the fall one needs only to recall the proud Inca, Atahualpa, standing before Pizarro declaring that he could not and would not swear allegiance to a ruler overseas, no matter how great, for *he* was the *Inca;* and then turn from this picture to the present ambitionless people with their hang-dog expression, stepping out of the road and uncovering as the mighty white man passes by.

Is all this a working field for the geographer? If it is the field has not born many fruits thus far. If it is not, we probably shall have to wait a long time for many of the problems to be cleared up. Perhaps it will be so long that these same problems now readily solvable will become unsolvable because we have waited too long.

URBAN DEVELOPMENT IN THE KENTUCKY MOUNTAINS

By D. H. DAVIS*

Current Descriptions of the Region.—A search of the literature in the field of serious contributions as well as that of fiction would lead to the belief that eastern Kentucky is "a backwoods where the civilization is that of the 18th century—where money is as scarce as in colonial days, and all trade is by barter,"[1] "a region without cities, without manufacturing, with but little mining—poor transportation, sparse population."[2] "Made road there is none; all that has been done since Daniel Boone came is the clearing away of logs and boulders. So the farmers live cut off from thought, literature, science and art. The great world, the rest of mankind, are no more real to them than they are to a man dropped into a mediaeval oubliette. Thus it is amid the confused tangle of the Cumberlands of West Virginia, eastern Kentucky and eastern Tennessee."[3]

Fig. 1. An improved road in Breathitt County. Typical of recent road construction in the Mountains.

John Fox describes his arrival at Jackson, the county seat of "Bloody Breathitt" as follows: "At Jackson a man with a lantern put me in a 'hack', drove me aboard a flat boat, ferried me over with a rope cable,

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[1] Semple, Ellen C. The Anglo Saxons of the Kentucky Mountains: Bull. Am. Geog. Soc. Vol. XLII, No. 8, pp. 561-594, 1910.

[2] Whitbeck, R. H. Fact and Fiction in Regional Geography: Jour. of Geog., March 1923, pp. 86-94.

[3] Ross, Edward A. Pocketed Americans: New Republic, p. 170, Jan. 9, 1924.

cracked his whip and we went up a steep muddy bank into the town—I saw between the curtains of the 'hack' what seemed to be a sidewalk of solid cement.—It was not a sidewalk of cement but a whitewashed board fence that had looked level in the dark, and except along a muddy foot-wide path close to the fence, passing through, for anything short of a stork on stilts, looked dangerous."[4] Writing more recently, Lucy Furman describes Jackson as "a mountain county seat famous for the terrible feud then raging" with "endless piles of ties and lumber" and the hotel as "an ugly frame house, backed into a cliff."[5]

These descriptions do not portray existing conditions. The railroad extends beyond Jackson and there are no extensive piles of ties and lumber; the river is crossed by a bridge, not a ferry; jitneys meet all trains and automobiles are a common sight on the streets; the hotel is a modern brick structure. The town boasts a good high school, a fine post office building, and a business section which would be a credit to a place much larger than Jackson, the population of which was only 1,503 in 1920.

Recent Urban Development.—The erroneous impression conveyed by the literature results from the fact that urban development in the Kentucky Mountains has been very recent. Even as late as 1870, only Ashland and Catlettsburg, both in Boyd County, had populations of more than one thousand. Most of the county seats at that time had populations not exceeding one hundred. In 1900, there were only three towns, Ashland (6,800), Catlettsburg (3,801), and Middlesboro (4,162) with populations of two thousand, five hundred or over in the mountains and all three are marginally located. Since 1900, however, urban growth has been rapid and the number of smaller towns has increased greatly. In 1920, there were 61 incorporated towns, 8 with populations of over two thousand five hundred, 17 with populations in excess of one thousand, and 11 with populations of from four hundred to one thousand. In addition, at least two unincorporated places, Lynch and Benham, had populations in excess of two thousand, five hundred. A large portion if not all of the increase in urban population between 1900 and 1920 resulted from the development of the coal resources. Urban development is still limited, however, less than ten per cent of the total population living in incorporated towns or unincorporated urban centers, though by comparison with other portions of Kentucky, the *number* of towns with populations of one thousand or over represents practically average conditions for the state.

[4] Fox, John. Down the Kentucky on a Raft, pp. 176-177, 1912.
[5] Furman, Lucy. The Quare Women, pp. 64-67, 1923.

LOCATION OF MOUNTAIN TOWNS:—Towns are in all cases located on main drainage lines in the area of creek bottom settlement, as in this region, lines of communication focus upon the principal valleys. These larger valleys are also the only areas where topographic conditions afford sufficient level land for city sites. Examples of towns so located are Jackson and Hazard on the North Fork of the Kentucky River and Pikeville, Prestonsburg and Paintsville on the Levisa Fork of the Big Sandy River. A city site on a main drainage line may also control a break in a mountain barrier as at Pineville, where the Cumberland River cuts through Pine Mountain. Middlesboro possesses a similar pass location, being strategically placed with reference to Cumberland Gap, the only feasible route across Cumberland Mountain for many miles.

In the area of ridge top settlement, streams are not always a determining factor in city location. In many of the more level portions of the plateau, where much of the older surface has been preserved, no one location possesses any particular topographic advantage which

POPULATION STATISTICS FOR THE MOUNTAIN COUNTIES—1920

County	Total population per sq. mi.	Per cent Urban in total population	County	Total population per sq. mi.	Per cent Urban in total population
Bell	88.5	32.2	Magoffin	45.9	
Boyd	184.2	34.3	Martin	33.7	
Breathitt	42.7		**Nenifee	28.5	
Carter	54.4		Morgan	45.3	
Clay	41.4		Owsley	36.2	
**Elliott	33.8		Perry	77.7	16.7
**Estill	61.3	17.3	Pike	63.5	
Floyd	68.7		**Powell	37.3	
Greenup	58.0		**Pulaski	54.2	13.7
Harlan	66.0	8.4	**Rockcastle	49.7	
Jackson	35.1		**Rowan	34.8	
Johnson	73.2		**Wayne	33.9	
Knott	33.5		Whitley	62.8	8.0
Knox	67.9	4.9	Wolfe	38.2	
Laurel	44.3				
Lawrence	41.8				
Lee	59.9				
Leslie	27.1				
Letcher	68.9				
McCreary	28.8				

** Only in part in the Mountains.

GROWTH OF POPULATION IN SOME OF THE INCORPORATED TOWNS

TOWNS	1920	1910	1900	1890	1880	1870
Ashland, Boyd Co.	14,729	8,688	6,800	4,195	3,280	1,459
Middlesboro, Bell Co.	8,041	7,305	4,162	3,271	....	....
Hazard, Perry Co.	4,348	537	....	....	....	....
Cattlettsburg, Boyd Co.	4,183	3,520	3,081	1,374	1,225	1,019
Jenkins, Letcher Co.	4,707	....	....	....	....	....
Corbin, Knox and Whitley Counties.	3,406	2,589	1,544	....	....	....
Pineville, Bell Co.	2,908	2,161	2,072	83	....	....
Harlan, Harlan Co.	2,647	657	557	....	....	....
Lynch, Harlan Co.	2,500 +	Estimate–		No ret	urn as	uninc.
Benham, Harlan Co.	2,500 +	Estimate–		No ret	urn as	uninc.
McRoberts, Letcher Co.	2,146	....	....	....	....	....
Pikeville, Pike Co.	2,110	1,280	508	456	246	140
Fleming, Letcher Co.	2,069	....	....	....	....	....
Louisa, Lawrence Co.	2,011	1,356	1,099	834	406	425
Van Lear, Johnson Co.	2,056	....	....	....	....	....
Hellier, Pike Co.	1,884	525	....	....	....	....
Barbourville, Knox Co.	1,877	1,633	1,010	1,162	250	436
Williamsburg, Whitley Co.	1,767	2,004	1,495	1,376	208	139
Russell, Greenup Co.	1,756	1,038	743	323	....	....
London, Laurel Co.	1,707	1,638	1,147	Not re sep.	t. 88	45
Prestonsburg, Floyd Co.	1,667	1,120	409	305	265	179
Jackson, Breathitt Co.	1,503	1,346	941	Not ret. se	p. 88	54
Olive Hill, Carter Co.	1,395	1,132	291	186	....	....
Paintsville, Johnson Co.	1,383	942	541	506	310	247
Wayland, Floyd Co.	1,362	....	....	....	....	....
Beattyville, Lee Co.	1,210	1,360	696	....	....	....
Weeksbury, Floyd Co.	1,016	....	....	....	....	....

Area of Mountains=10,450 sq. mi.=26% of area of State (40,181 sq. mi.)
110 towns in the State with a population of 1000 or over.
25 towns in the Mountains with a population of 1000 or over.

makes it markedly superior as a city site. Hence, in this portion of the Mountains, the determining factor has in most cases been the location of the railroads, major population centers springing up with the development of modern transportation. Towns with such locations are Corbin, primarily a railroad center, and London. Except in this por-

tion of the Mountains, however, the dominance of drainage lines in determining city sites has favored a marginal location for the larger foci of population.

Towns Not Southern in Plan.—The towns and cities of the mountain area, including those of the margin, are in few cases distinctively Southern in plan, Pineville furnishing one of the few examples of a town built around the court house square. This failure to follow the plan so common south of the Ohio River may be ascribed to regional topographic conditions which have controlled both the plan and the direction of growth of the communities and to the fact that much of the urban growth has been very recent and associated with mining development.

In the area of creek bottom settlement, the narrowness of the bottoms compels extreme attenuation of form. In communities in this area, growth must follow the stream course or the houses must cling to the sides of the hills which shut in the valley. Urban development

Fig. 2. A Portion of Lynch, Harlan County. The narrowness of the valley of Looney Creek has led to streets at two levels.

in the more level ridge top areas is not so restricted and a more compact type of town results. Middlesboro, in the southeastern portion of the Mountains, lies in a basin of sufficient size to allow expansion in all directions. Ashland and Catlettsburg extend along the Ohio River, but this results from the former importance of the river as a highway

rather than from topographic conditions, as there is an abundance of level land to care for expansion. Adjustment to local topographic conditions and the convenience of the individual communities have evolved a great variety of plans; in only a few cases has this resulted in grouping the town around the court house square.

Character of Towns.—In many portions of Kentucky, the towns are strikingly similar in character, differing essentially only in size and the exact degree of industrialization, but in the Kentucky Mountains, the diversity of cause which has led to urban development has produced considerable variation in the character of the urban aggregations. Some of the agglomerations are mining camps expanded to city size, with the economic life of the community centered about the activities of a single great mining company, as at Jenkins, Lynch, Benham and Stearns. In such centers of population, there is no industrial development aside from coal mining and civic pride is lacking. In other cases, cities, though primarily dependent upon coal mining, have developed independently of any mining company and small manufactures dependent upon local resources, have come into existence. These may be industries based on the timber resource, canning factories or clay working plants. Towns of this character were commonly county seats or important local centers prior to the development of the coal. In some cases, as at Jackson and Prestonsburg, the alteration and growth of the original center has been much less than it has been at Hazard and Harlan, where the metamorphosis has been so extensive that almost no traces of the original settlements remain. Middlesboro also serves as a center for a coal mining area, as do Hazard and Harlan, though its early prosperity traces back to an influx of English capital and the establishment of numerous industries which have for the most part proven failures.

The location of the marginal cities, Ashland and Catlettsburg, on the Ohio River on the northern margin of the area makes them more independent of the fortunes of the Mountains, for a portion of which they serve as distributing centers.

Regions of Slight Urban Development.—In the counties where railroads have not penetrated, and where conditions similar to those existing in all counties prior to the past two decades still persist, there is no urban development in the ordinarily accepted use of the term, though communities clustered about the court house are located in each county. These centers suffice to supply the limited needs of the rural community. Towns such as Hyden and Hindman belong to this class.

Urban Improvements.—In those urban centers of recent growth which depend directly or indirectly upon coal mining, the character of the development has been surprisingly good. Paved streets, sewer systems, and a satisfactory water supply are common. Schools, hotels, and the buildings which house the business of the community are substantial structures of brick, stone or cement. Many of the residences are attractive in appearance, and in few cases are they the poor shacks which are common in some rural sections of Kentucky. Aside from the newness which is inseparable from recent growth, these communities compare favorably with towns of similar size in most portions of the country.

Fig. 3. Main Business Street of Middlesboro, Bell County.

Possible Future Development.—The present urban growth forecasts the character of future development within the area, which will probably be limited to the establishment of a relatively large number of centers of small size rather than to the growth of two or three major foci of population. Topographic conditions hinder the establishment of large towns within the Mountains by restricting the area tributary to a single center and by imposing a limit on the amount of level land available for the expansion of a given community. Only in marginal locations are the physical conditions such that suitable sites for large cities occur. The smaller towns, as they develop, will not possess extensive manufactures, but will serve as distributing centers and markets for limited areas. As the coal resource becomes more completely de-

veloped, many of the more important minor population centers of today may be expected to repeat in some degree within the next twenty years the phenomenal growth enjoyed by Harlan, Lynch and Hazard during the past decade.

With increasing development of the mineral wealth, the urban population should constitute an increasingly greater fraction of the total population even though, within the Mountains, towns remain small in size. On the west, drainage lines focus upon Blue Grass centers; to the south, the "Mountains" continue without a break; to the east, topographic conditions are likewise unfavorable for the development of large urban centers. The northern margin, where drainage and rail lines converge on a line of contact of unlike areas, presents the maximum opportunity for the development of larger urban aggregations. In this region, therefore, Ashland and Catlettsburg, the largest towns of eastern Kentucky in the past and present, are located, and here also may be expected the maximum urban development of the future.